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Dried at 212°.			Formula deduced.		
Carbon . .	26.58		C_{23} =	138.0	26.93
Hydrogen .	2.86		H_{15} =	15.0	2.93
Oxygen . .	25.97		O_{17} =	136.0	26.54
Oxide of lead	45.36	44.59	2.PbO =	223.4	43.60
	100.00			512.4	100.00

The tribasic salt gives

Dried at 212°.			Formula deduced.		
Carbon . .	21.89	22.07	C_{23} =	138.0	21.20
Hydrogen .	3.06	2.82	H_1 =	18.0	2.76
Oxygen .	23.75	23.73	O_{20} =	160.0	24.57
Oxide of lead	52.30	51.38	3.PbO =	335.1	51.47
	100.00	100.00		651.1	100.00

If we consider the xanthorhamnine, as dried in the oil-bath, to be then anhydrous, the bodies analyzed become

Xanthorhamnine, dry = $C_{23} H_{12} O_{14}$.
do. dried at 212°. = $C_{23} H_{12} O_{14} + Aq$.
do. dried in vacuo = $C_{23} H_{12} O_{14} + 15 Aq$.

1st lead salt, $C_{23} H_{12} O_{14} + 2. PbO + 3 Aq$.
2nd lead salt, $C_{23} H_{12} O_{14} + 3 PbO + 6 Aq$.

The xanthorhamnine is thus formed by the addition of one equivalent of water and two of oxygen to the chrysorhamnine, as $C_{23} H_{11} O_{11} + HO + O_2 = C_{23} H_{12} O_{14}$. And if we were to consider the substance dried in the oil-bath at 320° still to retain an atom of water, it should be simply oxidated chrysorhamnine, being, when dry,

$$C_{23} H_{11} O_{11} + 2 O.$$

The Rev. H. Lloyd, V. P., read a supplement to a former communication "on a New Magnetical Instrument, for the measurement of the Inclination and its Changes."

Having, on a former occasion, explained the principle of this instrument, and given the details of its construction, it remains only that I should now describe the observations made for the purpose of testing its performance. I shall pass over for the present those which relate to the *absolute inclination*, because they have yielded results which can be regarded only as approximations to the truth, and I have not succeeded as yet in tracing the errors to their source. It is manifest, however, that an instrument may be a good *differential* instrument, while it is incapable of yielding absolute results; and there are special reasons why this should be the case with the apparatus now under consideration. Accordingly its failure in the latter respect, even though established, would furnish no ground for despairing of its success in the former.

It is obvious that the apparatus is wholly free from the sources of error already noticed, belonging to magnetical instruments moving on a fixed axle; and the only doubt of its performance must relate to the changes of induced magnetism in the iron bar. Thus it might be questioned, before trial, whether such a bar receives in all cases an amount of free magnetism proportional to the inducing force;—whether, again, the minutest changes in the latter are accompanied by corresponding changes in the former;—and whether, lastly, the changes thus produced are instantaneous, or, at least, demand no appreciable time for their development.

In the first experiments which I made, for the purpose of determining these questions, the induced magnetism of the iron bar was altered by means of a permanent magnet, placed in the same right line with the bar, and at a known distance from it. The effect produced upon the position of the suspended magnet being observed, the distance was altered by a known amount, and a new observation taken; and so on, at many different distances. Then, the law of action of the inducing magnet being known, we may calculate the changes of deflection of the suspended magnet, on the supposition that the changes of the induced force of the bar are proportional to those of the inducing action, and then compare them with the changes of deflection observed. The calculated and observed results of many series of observations, taken in this manner, were found to accord as nearly as the accuracy of the observations themselves allowed.

In making this comparison, however, it is necessary to take into account the effect of the *direct* action of the fixed magnet upon the suspended one. The axis of the former magnet being not far from the vertical passing through the centre of the latter, its action upon it and upon the iron bar follow, nearly, the same law; so that its direct effects upon the position of the suspended magnet are, very nearly, proportional to those which it produces through the medium of the induced force of the bar. On this principle the observed results may be cleared, approximately, of those parts of the changes which are foreign to the question. Still it must be admitted that such a complication of the results tends to weaken their evidence; and it was therefore desirable to obtain further proof, in a manner less exceptionable.

The object being to alter the inducing action according to a known law, and to observe the changes of the induced force, as shown by the position of the suspended magnet, it is manifest that it may be attained by simply varying the angle which the iron bar makes with the direction of the earth's magnetic force, the distance of its pole from the suspended magnet remaining unchanged. In fact, it will be seen, by pursuing the same reasoning as before, that if R denote the total force of the earth, and ψ the angle which the bar makes with its direction, the equation of equilibrium of the suspended magnet is

$$p\mathrm{R}\cos\psi + q = \mathrm{X}\tan u\,;$$

the line connecting the pole of the bar with the centre of the suspended magnet being, as before, perpendicular to the magnetic meridian. Hence, if the bar be devoid of permanent magnetism (or $q = 0$), and if the forces R and X remain unchanged during the experiments, we have

$$\tan u = a \cos\psi,$$

a being a constant.

In order to observe whether the deflections of the suspended magnet obeyed this law, a small divided circle was attached to the piece upon which the iron bar moved, in such a manner that the axis of the pivot passed through its centre. The circle being fixed, and the bar connected with the moveable arm carrying the vernier, we have the means of determining the angle through which it is moved. The plane of the motion coinciding with the magnetic meridian, the inclination of the bar to the vertical was altered by 5° between the successive observations of the position of the suspended magnet. The following Tables contain the results of two such series of observations. The first column of each gives the inclination of the bar to the vertical; the second, its inclination (ψ) to the direction of the magnetic force, i. e. the former angle increased by the complement of the magnetic inclination (19° 10′). The third column contains the observed readings of the scale, corresponding to the positions of the suspended magnet; the fourth, the differences between each of these readings and the reading belonging to the vertical position of the bar, converted into angular measure; the fifth, the actual deflections; the sixth, the *calculated* deflections, as deduced by the formula given above; and the seventh, the differences.

In order to derive the numbers of the fifth column from those of the fourth, it is necessary to know the deflection corresponding to the vertical position of the bar. This angle is determined by placing the bar vertically, with its acting pole above and below successively, and noting the readings of the horizontal circle, when the same division of the moveable scale, reflected by the mirror, was brought to coincide with the fixed wire of the telescope. The differences between each of these readings, and the similar reading when the bar is removed, are double the deflections corresponding to the two positions of the bar; and, when they are nearly equal, the mean of these deflections may be taken as that due to the induced force.

FIRST OBSERVATION.

Acting end of bar a south pole, reading = 14° 8′, deflection = 17° 0′
„ north pole, . 82 51, „ = 17 22
Bar removed, . 48 7, mean = 17 11

Inclination to vertical.	ψ.	Reading of Scale.	Angular Differences.	u Observed.	u Calculated.	Difference.
+ 14° 30′	33° 40′	2·2	− 1° 56′.2	15° 14′·8	15° 14′·5	+ 0′·3
+ 10 0	29 10	13·2	− 1 12·4	15 58·6	15 57·2	+ 1·4
+ 5 0	24 10	23·1	− 33·0	16 38·0	16 37·8	+ 0·2
0 0	19 10	31·4	0·0	17 11·0		
− 5 0	14 10	37·5	+ 24·3	17 35·3	17 36·7	− 1·4
− 10 0	9 10	42·8	+ 45·4	17 56·4	17 54·7	+ 1·7
− 13 30	5 40	45·8	+ 57·3	18 8·3	18 2·7	+ 5·6

SECOND OBSERVATION.

Acting end of bar a south pole, reading = 14° 23′, deflection = 16° 36′
„ north pole, . 82 15, „ = 17 20
Bar removed, . 47 35, mean = 16 58

Inclination to vertical.	ψ.	Reading of Scale.	Angular Differences.	u Observed.	u Calculated.	Difference.
+ 15° 0′	34° 10′	2·6	− 2° 1′·8	14° 56′·2	14° 57′·8	− 1′·6
+ 10 0	29 10	14·4	− 1 14·8	15 43·2	15 45·0	− 1·8
+ 5 0	24 10	24·8	− 33·4	16 24·6	16 25·2	− 0·6
0 0	19 10	33·2	0.0	16 58·0		
− 5 0	14 10	40·0	+ 27·1	17 25·1	17 23·3	+ 1·8

In the preceding observations a telescope of low power was employed, and the arc-value of a single division of the scale (which was at the distance of eighteen inches from the mirror) was 3′.98. The differences of the observed and calculated results, therefore, do not in general exceed the amount which may be fairly ascribed to errors of observation; and the accordance is sufficient to establish the fact, that the changes of the induced force of the bar are, within the observed limits, proportional to those of the inducing action. It is important to observe also that the changes of the induced force, produced artificially in these experiments, are much greater than any which are likely to arise from the variations of the vertical component of the earth's magnetic force, and therefore that the experiments may be regarded as severe tests of the performance of the instrument.

The preceding observations further showed, that the changes in the inducing force were *instantly* followed by their effects upon the suspended magnet; so that the changes of induced force required no appreciable time for their development. It remained only to ascertain, in a somewhat fuller manner, how far the bar was susceptible of minute magnetic changes, from very small variations of the acting force. For this purpose, a series of readings of the scale was taken, the inclination of the bar to the vertical being altered by half a degree between the consecutive readings. The *mean* difference of the successive readings was found to agree, very exactly, with the calculated difference; while the *partial* differences deviated from the mean by an amount not exceeding the limits of error of observation. It may be presumed therefore, that the changes of the induced force in the iron bar are continuous; and, accordingly, that the sensibility of the instrument is only limited by the optical power, which is applied to observe the changes of position of the suspended magnet.* In the experiments above described, the arc-value of the divisions of the scale was 3′.98; with the modifications since introduced into the reading part of the apparatus, the scale divisions have nearly the same value as in the instrument for the measurement of the declination, so that the readings may be made with certainty to less than the tenth of a minute. The present value of the inclination in Dublin is about 70° 50′; and the mean deflection produced by the iron bar in its actual position being about 19°, it follows from (7) that the changes of inclination are inferred with the same degree of precision, very nearly, as the observed changes of angle.

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* Against this conclusion is the fact, that considerable changes in the induced force of the bar seem to be attended with some *permanent* changes of polarity; and it may be presumed that the same thing will take place, in a proportionate

The last test to which the instrument was subjected, was, to employ it for some time in the regular observation of inclination changes, for which it is destined; and to ascertain how far the mean results of the observations of successive weeks agreed in exhibiting the law of the diurnal variation. The instrument was accordingly observed for five successive weeks, every second hour during the day and night, and the means calculated, omitting those days in which the series was broken by changes of adjustment during experiment. The curves now laid before the Academy represent the projected results of the observations of each of these weeks, together with that of the mean of the whole. An inspection of them is sufficient to show that the curves of the separate weeks accord with one another, and with the mean, as nearly as can be expected in the results of such limited series, the discordances being only such as are due to the known irregularities in the direction of the earth's magnetic force.

A communication from the President was read, containing some remarks supplementary to the account which he had given at a former meeting, of his Researches respecting Fluctuating Functions, (see Proceedings, June 22nd, 1840).

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degree, with the minute changes induced by the variations of the earth's force. It remains for future examination to determine how far such permanent changes, if they occur, may impair the accuracy of the results.